

LOCATION AND DESIGN DIVISION

INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: GUARDRAIL REPAIR, REPLACEMENT AND UPGRADE GUIDELINES	NUMBER: IIM-LD-220.2 MM – 327 CD – 2003 – 4
SPECIFIC SUBJECT:	DATE: NOVEMBER 21, 2003
	SUPERSEDES: IIM-LD-220.1 TE - 305 CD – 2001 - 9
LOCATION AND DESIGN DIVISION APPROVAL: Mohammad Mirshahi, P.E. Approved November 12, 2003	SCHEDULING & CONTRACT DIVISION APPROVAL: W. Byron Coburn, Jr., P.E. Approved November 19, 2003
MOBILITY MANAGEMENT DIVISION APPROVAL: Raymond J. Khoury, P.E. Approved November 20, 2003	ASSET MANAGEMENT DIVISION APPROVAL: James R. Smith, Jr. Approved November 21, 2003

Changes are shaded.

CURRENT REVISION

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- This memorandum has been revised for clarification and emphasis in several areas.
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EFFECTIVE DATE

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- These instructions are effective upon receipt.
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POLICY

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- These instructions apply to the Repair, Replacement and Upgrade of Existing Guardrail Installations Only. New Installations SHALL be in accordance with current VDOT Standards.
 - For the following situations all existing substandard guardrail systems and components shall be upgraded to the latest standard in accordance with current VDOT Road and Bridge Standards and this memorandum.

1. When located within the project limits of a construction project. When the line of rail extends outside the project limits, if more than 60% of the existing substandard line of rail lies within the project limits, then the entire run shall be replaced/upgraded as a part of that project.
2. When guardrail needs to be repaired/replaced under a maintenance project and/or contract (e.g. guardrail, pavement, etc.).

During routine maintenance projects and/or contracts of any roadway, all guardrail shall be reviewed, deficiencies identified, costs budgeted, and schedules set for replacement or upgrading to ensure that all existing guardrail meets current VDOT Standards. During these reviews if the guardrail is found to be more than 75 mm (three inches) lower or 75 mm (three inches) higher than current Standard requirements, then replacement or resetting shall be scheduled as soon as possible. For strong post guardrail (Standard GR-2) no metal blockouts are to be replaced in-kind or installed new, and no washers will be used other than those for the last 15.2 meters (50 feet) of a trailing end anchorage.
3. When located within the project limits of transportation improvements associated with permitted land development projects.
4. When any road is taken into the State roadway systems, all guardrail must comply with current Standards, and must include NCHRP 350 approved terminals and rail systems.

GUARDRAIL TERMINALS – DAMAGED AND SUBSTANDARD

- All terminals shall be installed as they were tested in accordance with NCHRP 350. Lapping of guardrail must be in the direction of traffic, per NCHRP 350 testing. DO NOT CHANGE THE DIRECTION OF THE LAPPING.
- When terminal damage occurs, a site investigation shall be made to determine whether the terminal should be repaired, replaced or eliminated. If a gap exists between two runs of guardrail and it is approximately 60 meters (200 feet) \pm , closing the gap by continuing the run of guardrail is recommended, thereby eliminating the need for a terminal. If a cut slope is within approximately 60 meters (200 feet) \pm longitudinal distance from the location of the terminal and is sufficient to install a Standard GR-6, the guardrail shall be extended to the cut slope and a cut slope terminal (Standard GR-6) should be used.
- If the installation site does not provide at least 22.8 meters (75 feet) of clear run-out path in addition to the length of need required for the barrier (exclusive of the terminal), a parallel terminal (Standard GR-9) shall be used instead of a flared terminal (Standard GR-7). If an extensive amount of grading would be required for site preparation to install a flared terminal (Standard GR-7), consideration should be given to using a parallel terminal (Standard GR-9) that does not require as much site preparation.

- The site preparation for all installations shall be in accordance with current Standards.
- Before replacing a damaged or substandard terminal, the location of the existing terminal should be checked to ensure sufficient length of need has been provided in the run of guardrail to adequately shield the hazard for which it was installed. In some cases it may be necessary to extend the guardrail to better shield the hazard or to provide for a more suitable site that would not require grading.

- **Breakaway Cable Terminals (BCT's)**

BCT's had concrete footings for the first two posts, did not have the metal strut at ground level between the first two posts and all posts were not breakaway.

Completely replace BCT's with new NCHRP 350 approved terminals whenever they are damaged or if they are within the limits of a construction or maintenance project/contract.

- **Modified Eccentric Loading Terminals (MELT's)**

The MELT provides a 1.2-meter (4-foot) offset, a 1.5-meter (5-foot) flat area behind the first post and a metal strut at ground level between the first two wooden breakaway posts.

If the MELT (Standard GR-7) is improperly installed or when damage includes the nose assembly and first two posts, replace with new NCHRP 350 approved terminals (revised Standard GR-7) such as the SRT-350, FLEAT 350, REGENT or other approved NCHRP 350 product. When replacing substandard GR-7 terminals, make sure that the section of rail and posts adjoining the new terminal installation is at the proper height.

- **Strong Post Turned-down Terminals (Std. GR-5's)**

All turned-down strong post terminals (run-on locations) should have already been removed from roadways on the National Highway System. Any that have not been removed shall be removed immediately.

When these terminals that may remain on non-NHS roadways are damaged, they shall be replaced with NCHRP 350 approved terminals.

- **Weak Post Turned-down Terminals (Std. GR-8, Type II's)**

Since no weak post terminals have been approved in accordance with NCHRP 350 for use in run-on locations, any of these terminals that are damaged shall be replaced with NCHRP 350 approved strong post terminals incorporating the appropriate transition required between a strong post terminal and weak post guardrail (in accordance with VDOT Road and Bridge Standards), regardless of the design speed of the roadway.

Any weak post run-on terminals within the limits of a construction project, maintenance project and/or contract shall be upgraded as part of the project.

For run-off locations, turned down terminals incorporating a concrete anchor (Standard GR-8, type I or II) are acceptable, regardless of the design speed of the roadway; however, the Type I and II terminals shall be outside of the clear zone of opposing traffic on two-way roadways. This includes existing installations in locations with design speeds greater than 70 km/h (45 mph) for which new installation of weak post guardrail must be in accordance with the new approved TL-3 weak post design.

- **TERMINALS BURIED IN THE CUT SLOPE (OLD STANDARD GR-6)**

Existing GR-6 installations that are not NCHRP 350 compliant (in accordance with current VDOT Standards) should be evaluated to ensure the following:

- Proper Height per current standards -

Where existing GR-6 Terminals were installed with the height of rail following the ground line at a height of 27" to 28", this installation method caused the terminals to be low, both in front of and behind the ditch line. These low installations may allow an errant vehicle to vault over the top rail and go behind the guardrail, failing its intended protection from hazards.

- The end anchorage is sufficiently buried in the slope 0.3 m (min. 1 foot cover).

Repair or replacement of either of these situations shall be to current VDOT Standards.

FIXED OBJECT ATTACHMENTS (FOA'S)

- Whenever a substandard fixed object or BR-GR attachment is damaged, it shall be replaced or upgraded with current Road and Bridge Standard fixed object attachments including the nesting of the rail, shortened post spacings and rubrail.
- When substandard FOA's or BR-GR's exist within the limits of construction projects or when replacement is required under a guardrail maintenance project and/or contract; both FOA's and BR-GR's shall be upgraded or replaced in accordance with the current VDOT Road and Bridge Standard.

W-BEAM GUARDRAIL

- During NEW CONSTRUCTION, always install to the current Standard heights.
- ALL W-beam guardrail panels shall be lapped in the direction of traffic. With two-way traffic, the laps on the right side of traffic are to be in the direction of traffic or toward the downstream end.

- Any existing guardrail (**GR-2, GR-8**) that does not meet current VDOT Standards or is identified to be greater than 75 mm (three inches) higher or lower than the Standard for the system being used, shall be scheduled for resetting or replacement. For sections of guardrail that are longer than 60 meters (200 feet), if more than 60% of the entire run has been damaged, or does not meet current Standards, the entire run shall be replaced with current Standards. If less than 60% of the entire run has been damaged, the damaged section should be replaced with current Standards.

- Weak post W-beam Guardrail (Std. GR-8)**

When substandard GR-8 is damaged, the extent of damage should govern repair/replacement. If the total run of guardrail is 60 meters (200 feet) or less, the entire run shall be replaced with the latest GR-8 design (which meets NCHRP 350 Test Level 3 criteria) or if the particular site conditions are appropriate a Standard GR-2 or GR-3 system can be used.

For substandard sections of GR-8 guardrail that are longer than 60 meters (200 feet), if more than 60% of the entire run has been damaged, or does not meet current Standards, the entire run shall be replaced with the latest GR-8 design or if the particular site conditions are appropriate a Standard GR-2 or GR-3 system can be used.

If less than 60% of the entire run has been damaged, the damaged section should be replaced with the latest GR-8 design or if the particular site conditions are appropriate a Standard GR-2 system can be used.

When either of these designs is used, the proper transitions **MUST** be incorporated. Transitions to the new height, splice locations and backup plates for the GR-8, and for the GR-2 transitions from GR-8, 8A, 8B to the GR-2 must be done in accordance with current Standard designs. The latest GR-8 design can be used even for speeds greater than 70 km/h (45 mph).

Existing weak post W-beam, not meeting NCHRP 350, that is within the limits of a reconstruction or maintenance project shall be upgraded to the new Standard design. When resetting or reusing rail, the height of the rail shall be installed to meet the current VDOT Road and Bridge Standards.

- Strong Post W-beam with 12' 6" Post Spacing and no blockout (Std. GR-1)**

All Standard GR-1 guardrail should be identified and replacement schedules set for all roadway systems so that appropriate funding can be budgeted for upgrades. Standard GR-1 on any roadway within the National Highway System (NHS) shall receive first priority for upgrading as soon as possible.

Existing strong post guardrail (Standard GR-1) and end terminals within the project limits of any project/contract should always be replaced with a new NCHRP 350 approved system.

When damaged, the extent of damage should govern repair/replacement. If the total run of guardrail is 60 meters (200 feet) \pm or less, the entire run shall be replaced with strong post (Standard GR-2) guardrail.

For sections of guardrail that are longer than 60 meters (200 feet), if more than 60% of the entire run has been damaged, the entire run shall be replaced with strong post (Standard GR-2) guardrail. If less than 60% of the entire run has been damaged, the damaged section should be replaced with strong post (Standard GR-2) guardrail.

- **Strong Post W-beam Guardrail with Steel Posts (Std. GR-2)**

When damaged, replace in kind in accordance with current standards; **NO STEEL BLOCKOUTS shall be used.** Rectangular washers shall be removed on a regular run of guardrail with the exception that washers should still be retained or added to the last 15 meters (50 feet) of a trailing end to provide end anchorage on the run-off end of a one-way roadway. Discard the steel blockouts and use routed 150x150x360 mm (6"x6") wood or composite blockouts. The wood and composite blockouts can be used interchangeably within a single run of guardrail for both NEW or repair, replacement and upgrades. When existing 150x200x360 mm (6x8) wood or composite blockouts are replaced during repairs, the blockouts shall include routing to prevent blockouts from rotating. When wood posts with wood blockouts are used, they should have **TWO** nails (one on each side) to prevent rotation of blockouts.

When posts are **removed** and meet current specifications for **reuse**, they should be reused only if they **are 1.75 m (5' 9") or longer** with Standard wood or composite blockouts. When resetting rail, the posts shall be removed and the holes backfilled prior to reinstalling the posts. The height of the rail should be measured to ensure it meets the current VDOT Road and Bridge Standards.

CABLE GUARDRAIL (STANDARD GR-3) DAMAGE

- When damaged, replace in kind in accordance with current VDOT Road and Bridge Standards (Standard GR-3).
- Any existing GR-3 that is identified to be more than 75 mm (three inches) lower or 75 mm (three inches) higher than current Standard requirements shall be scheduled for resetting.